Ministry of Defence

FCAS SUSTAINABILITY STRATEGY

Contents

Foreword

Director Future Combat Air (MoD)

In an era of rapidly evolving technological advancements and global challenges, the imperative for sustainable aerospace solutions has never been greater. The UK's Future Combat Air System (FCAS) commitment extends beyond national borders as we collaborate with industry partners and international allies to pioneer a new era of combat air capabilities while aligning with the Royal Air Force's (RAF's) ambitious goal of achieving Net Zero by 2040.

This strategy stands as a testament to our unwavering dedication to innovation and environmental stewardship. By uniting with industry leaders, we harness collective expertise to drive sustainable practices throughout the aerospace sector, contributing directly to the RAF's Net Zero mission. Through strong international partnerships, we amplify our impact, setting a precedent for cross-border cooperation that safeguards both national security and the environment.

We're embarking on a transformative journey that will shape a future where cutting-edge combat air capabilities are not only synonymous with national defence but also with global economic, social and governance responsibilities. Together, we are charting a course toward a safer, more sustainable, and interconnected world, while playing a pivotal role in realising the RAF's Net Zero vision.

Richard Berthon
Director Future Combat Air (MoD)

Industry Senior Responsible Officers (SROs)

As leading players in the UK industrial sector, we understand the importance of sustainability in all aspects of our operations.

Given the increasing threat of extreme weather events, the global stresses on our supply chains, and the geopolitical tensions emerging around access to critical minerals and materials, it is our responsibility to ensure we embrace environmental sustainability and circular economy principles through the life of the products we design. We also recognise the changing climate as a threat multiplier and the need to ensure our products are resilient to the conditions of a climate changed world. This is why we are driven to align with the UK Ministry of Defence's (MoD's) Climate Change and Sustainability Strategic approach, which seeks to drive innovation and collaboration across the defence sector to create a more sustainable and resilient future.

We recognise that our actions have a direct impact on the environment. We are committed to taking a proactive approach to understanding the path towards a Net Zero capable FCAS programme in support of the RAF's Net Zero 2040 ambition and the goals of the Defence Aviation Net Zero Strategy, as well as promoting sustainable practices and transformation throughout our supply chain.

FCAS will be a driving force in developing sustainable through life design and support practices for the defence sector. We are committed to working with our partners in government, academia, and industry to develop and implement sustainable practices that will ensure the long-term viability of our sector, contribute to protecting the planet and maintaining security for future generations.

Executive Summary

The FCAS Sustainability Strategy outlines an ambition for how the FCAS programme will contribute to the goals of the UK MoD's Climate Change and Sustainability Strategic Approach[1], the RAF's 'NetZero by 2040'[2] target, and the goals of the Defence Aviation Net Zero Strategy[3]. This strategy has an initial focus up to 2025 and includes the necessary shaping work required through to 2050 and beyond for the whole FCAS programme. The strategy is specific to FCAS, referring to the UK's wider future combat air requirement, with a crewed aircraft at its heart supported by additional "systems of systems" to deliver its full capability.

This strategy is complimentary to the Strategic Command Sustainable Support Strategy[4] and the 2018 Combat Air Strategy[5] but specifically looks at how the FCAS programme could develop a Net Zero capable FCAS[6] system of systems. To support this ambition and provide further detail of how it will be achieved, an implementation plan will follow this strategy.

This programme will be transformational in its approach and the FCAS Sustainability Strategy will outline why sustainability must be considered at every stage and the actions needed to work towards achieving Net Zero.

Five strategic sustainability objectives have been developed for this paper to break down the different areas of influence the FCAS programme can have. These are:

1. **Improve enterprise resilience to climate change.** Designing the FCAS programme end products and support solutions to be able to operate in a climate changed world, with the associated risks understood and assessed.

2. **Realise opportunities for Enterprise resilience.** Identify and utilise new technologies, materials, and digital capabilities, from the earliest stages of the programme to improve overall enterprise resilience and align with relevant MoD policy around through life support.[7]

3. **Maximise contribution to society.** The FCAS programme should make demonstrable and measurable progress against the UK Social Value Model (SVM) and contribute to a selection of the United Nations (UN) Sustainable Development Goals (SDGs). The FCAS programme should make decisions that considers the impact on economics, society, and the environment.

4. **Minimise negative contribution to the environment.** The entirety of the FCAS programme should incorporate sustainability thinking and consider sustainability goals. This includes working to deselect environmentally hazardous materials (such as F-gases) and, where possible, selecting materials that are able to be recycled. Environmental impact metrics should be considered and integrated into relevant trade off and decision points across the programme. FCAS should also contribute to the Ends defined in the RAF's Net Zero 2040 strategy. This strategy outlines a Net Zero capable ambition for systems entering service in 2035.

5. **Maximise contribution to National Value Framework (NVF).** Sustainability needs to be at the heart of the FCAS programme, which will innovate, develop and support UK "green" industry and academia through collaboration with SMEs and universities. Impacts and outcomes will be measured against the NVF outlined in the 2018 Combat Air Strategy.

Following the formal announcement of the Global Combat Air Programme (GCAP) partnership with Italy and Japan in December 2022, the UK will work with the tri-lateral partners to identify opportunities presented by adopting a common approach to sustainability.

[1] https://www.gov.uk/government/publications/ministry-of-defence-climate-change-and-sustainability-strategic-approach

[2] https://www.gov.uk/government/speeches/cas-raf-netzero-ambition

[3] https://www.gov.uk/government/publications/defence-aviation-net-zero-strategy

[4] https://www.gov.uk/government/publications/sustainable-support-strategy

[5] https://www.gov.uk/government/publications/combat-air-strategy-an-ambitious-vision-for-the-future

[6] FCAS Outline Business Case 1 refers to the The Concept of Employment (CONEMP) and JROC-endorsed Single Statement of User Need for the FCAS Programme:'The capability must be: effective, competitive, exportable, adaptable, **sustainable**, resilient, safe to operate, legal, and international by design.'

[7] https://www.kid.mod.uk/maincontent/business/sse_21/index.htm

Purpose

The FCAS Sustainability Strategy describes the challenges, opportunities, and objectives necessary to create a sustainable Net Zero capable FCAS. It lays out a series of ambitions, aligned to the UN Sustainable Development Goals (SDGs), the SVM, the MoD's Climate Change and Sustainability Strategic Approach, and the Defence Aviation Net Zero Strategy. The intent is for this strategy to guide the FCAS programme in adopting a "sustainability business as usual" approach, to ensure Sustainability considerations are demonstrably embedded in the programme's processes, behaviours, decisions and outcomes.

Scope

This sustainability strategy encompasses:

- All elements of the FCAS systems of systems, throughout the CADMID/T product life-cycle.
- Activities that support the goals of Epoch 1 of the MoD's Climate Change and Sustainability Strategy Approach (to 2025).
- Shaping work required for Epoch 2 (2025-2035), Epoch 3 (2035-2050) and beyond, including terminal and disposal elements of the programme.
- Considering sustainability elements of economy, cost and environment, aligned with a selection of UN Sustainable Development Goals.

Figure 1 - UN Sustainable Development Goals

Context

Climate change is identified as "one of the greatest threats to both UK and global security and prosperity"[8]. Extreme weather events are increasing; flooding, droughts, fire and rapid loss of natural habitats are leading to humanitarian crises such as food, energy and water security, disaster relief and mass migration. This deteriorating situation has profound implications for defence and security on a global international scale.

For example, water is widely used as part of the support of assets through routine maintenance, as well as extensively used throughout the supply chain as part of component manufacture and assembly. Continued access to water is therefore critical in supporting these operations, with supply potentially under strain through the effect of increasing and persisting droughts.

In 2023, the UK Critical Minerals Strategy[9] was refreshed as part of the updated Integrated Review, with a focus on setting out the government's plans to improve the resilience of critical minerals supply chains and increasing the security of supply. In order to maintain freedom to modify product through life, it is imperative that the access to these critical minerals and materials is maintained by moving from a "throwaway" culture to one that embraces a circular economy, in order to alleviate pressure on critical supply.

In 2019, the UK government established a legal requirement to reach Net Zero carbon emissions by 2050. The MoD - 1 of 123 government departments - is responsible for 50% of central government emissions, with Defence Aviation emissions creating approximately 35% of these emissions in 2019/2020. As a result, the MoD will play an important role in meeting the UK's domestic and international commitments. Further, Defence Aviation emissions contributed approximately 35% of the MoD's emissions in 2019/20[11].

Whilst preserving defence's primary purpose[12] there is clear direction to reduce emissions and increase sustainability within the MoD. In March 2021, the MoD published the ambitious Climate Change and Sustainability Strategic Approach, with three goals for 2050:

- For defence to have adapted to operate freely and effectively in hostile physical environments.
- For defence to have reduced emissions and increased sustainability activities, contributing to the UK government achieving Net Zero 2050
- For defence to be a global leader in responding to geopolitical threats exacerbated by climate change.

In support of these ambitions, the RAF - the MoD's largest emitter of carbon and other emissions - aims to achieve Net Zero by 2040[13].

The MoD's plans for sustainability address its social, economic and environmental responsibilities. The MoD is facing increasingly complex challenges such as those around escalating costs, recruitment, retention, equipment/technology obsolescence, spiralling threat and inter-operability demands. It is critical to accelerate decision-making in relation to operational fuel choices, power systems and energy infrastructure if the UK military is to avoid capability becoming isolated, expensive, and vulnerable.

The UK's FCAS, which is in its concept and assessment phase, is no exception. The programme should ensure sustainability requirements are fully considered from this early stage in order to maximise benefit through life. Collaboration and integration are critical to delivering an affordable, available, sustainable and effective air capability. FCAS will align with the requirements of the SSE21, utilising the Guide to Engineering Activities and Reviews (GEAR)[14] for guidance, as well as align with Strategic Command's Sustainable Support Strategy 2022.

[8] https://www.gov.uk/government/publications/a-changing-climate-exploring-the-implications-of-climate-change-for-uk-defence-and-security

[9] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1097298/resilience_for_the_future_the_uks_critical_minerals_strategy.pdf

[10] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/973707/20210326_Climate_Change_Sust_Strategy_v1.pdf

[11] https://www.gov.uk/government/publications/defence-aviation-net-zero-strategy

[12] About us - Ministry of Defence - GOV.UK (www.gov.uk)

[13] https://www.gov.uk/government/speeches/cas-raf-netzero-ambition

[14] https://www.kid.mod.uk/maincontent/business/sosa/content/sosa_gear.htm?zoom_highlight=gear

Our Ambition

Our ambition is for the FCAS programme to deliver a **through-life Net Zero capable system of systems at Entry Into Service (EIS), in support of the wider RAF Net Zero 2040 ambition.** This will be measured in terms of the total CO2e for GHG Protocol Scope 1, 2 & 3 emissions attributable to the production of the FCAS system(s) and its through-life operation and support, achieved through carbon reduction, avoidance, and removal.

FCAS will embed sustainability at the heart of programme decision-making. The programme will generate evidence that demonstrates the environmental impact, social value contributions and national economic benefit of the programme. The programme will identify and mitigate climate change risks and enhance resilience across the FCAS Enterprise across themes including, but not limited, to the built environment, support, supply chain, logistics and energy. **The programme will clearly demonstrate links between a sustainable FCAS Enterprise and the NVF.**

We will use the programme as a **means to encourage and accelerate green investments** in transformational technologies, **stimulate growth** amongst green SMEs across the UK, and **spark innovation and a decarbonisation revolution** throughout the supply chain.

Our vision is for FCAS to be the flagship defence programme for the UK's ambition to be a global leader in Net Zero, and project our influence across the globe. "Generation Tempest "[15] is simultaneously Generation Net Zero; making a difference on Tempest can become an inspiration for a new generation of Net Zero engineers and problem solvers. We will embed sustainability at the heart of the programme and communicate it externally as part of our core operating model.

FCAS will also aim to embed "circular economy" principles throughout its life-cycle, such as designing for reuse/recovery/recycling. This will act to not only reduce the environmental impact of the programme, but also improve supply chain resilience and maintain freedom to modify by keeping critical raw minerals and materials in the loop.

We envisage FCAS to become the most successful and visible example of how UK defence can produce a world-leading sustainable product against the backdrop of increasing geopolitical, economic, and environmental uncertainty.

[15] Tempest is the name currently being used by the UK for the crewed aircraft being developed by GCAP, at the heart of the FCAS programme.

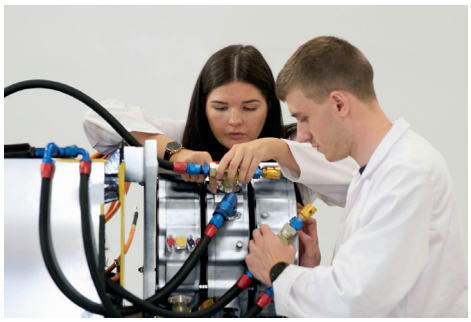
Strategic Objectives

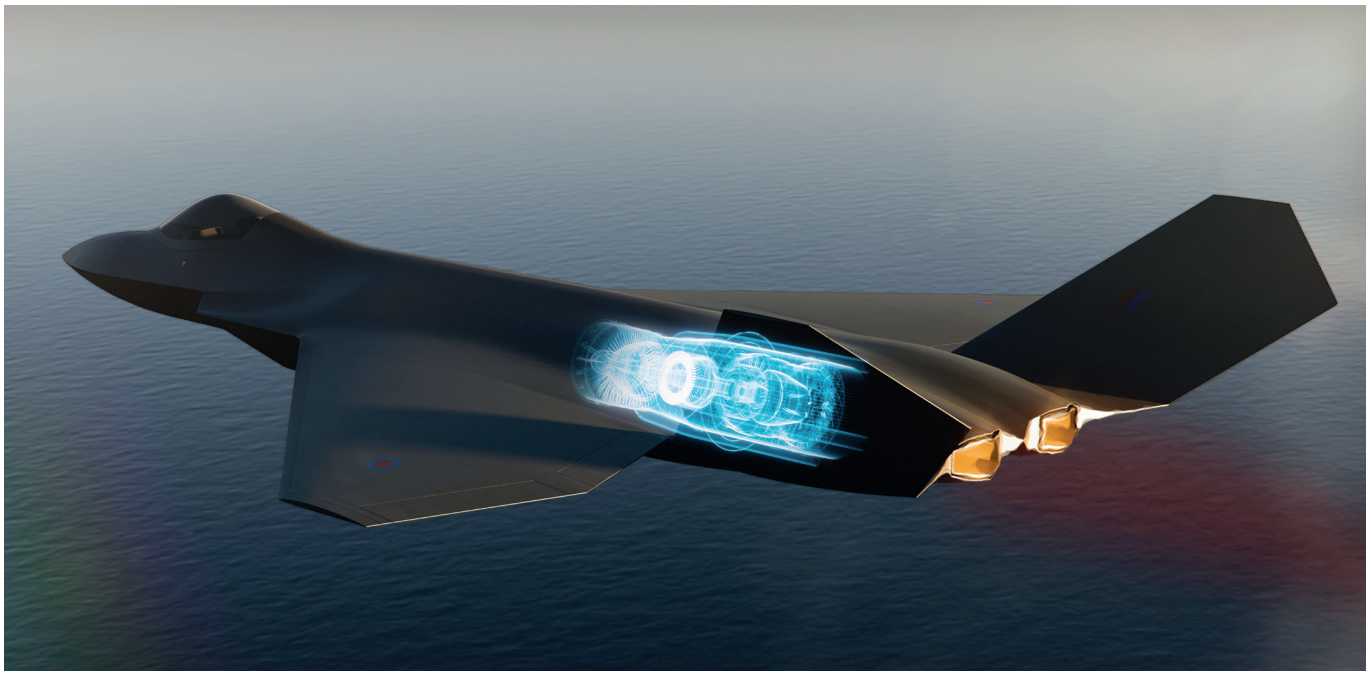
In developing this strategy, analysis identified five strategic objectives:

1. ***Improve enterprise resilience to climate change***
2. ***Realise opportunities for Enterprise resilience***
3. ***Maximise contribution to society***
4. ***Minimise negative contribution to the environment***
5. ***Maximise contribution to the National Value Framework (NVF)***

These five objectives are areas within the FCAS programme's direct sphere of influence and represent opportunities to address programmatic levers that can yield significant climate change and sustainability benefits. They offer a framework against which performance and outcomes can be measured and judged, using developed and quantifiable success criteria.

We also identify an "epoch by epoch" approach to achieving these objectives, with timeframes aligned to the epochs from the MoD's Climate Change and Sustainability Strategic approach. Epoch 1 will focus on "setting the foundations" with a broad intent to embed sustainability as "business as usual" within our ways of working.





Strategic Objective 1

Improve Enterprise Resilience to Climate Change

The Problem

The UN recognises climate change as a threat multiplier[16] – factors such as increased migration acting to likely drive future conflict and increasing demand on the defence operator.

Extreme weather events are likely to become more frequent in the future. In the UK, flooding is expected to be one of the most pressing climate change risks to people, communities, and buildings over the next five years.[17]

Rising temperatures could also induce heat-related deaths and the overheating of military installations, homes, hospitals, care homes, offices, schools, and prisons.

A recent RAND report[18] highlighted the climate associated risks to the Defence Lines of Development (DLOD) and the significant potential to disrupt freedom to operate for operators of the FCAS.

The Analysis

The programme should ensure that the FCAS Enterprise remains resilient to the effects of climate change to maintain global freedom to operate. Likewise, much of our global critical industrial and defence infrastructure is located in climatically vulnerable locations[19], such as next to rivers, or near to flood plains.

A summary of the potential effects of climate change on the FCAS Enterprise can be seen below:

- **Concepts & Doctrine:** Increased humanitarian and disaster relief scenarios will likely result in renewed focus on the role the MoD plays in support of the civilian setting. The role FCAS will play in the whole force doctrine could evolve over time as the MoD repositions to help mitigate the effects of climate change.

- **Training:** Climate change events may reduce the availability of existing training sites, particularly pertinent to a programme that will pioneer an increase in synthetic flying. Likewise, there may be health and safety issues associated with training programmes subjected to flooding and extremely high temperatures.

- **Personnel:** Climate change is likely to impact the physical and psychological wellbeing of personnel, whilst having to face an environment defined by increasing disease transmission and geopolitical unrest. Climate change will also change people's perception of what they regard as important in their lives and must not be underestimated as both a driver for new technology being developed and as a factor for future recruitment.

- **Equipment:** Global temperature rises are likely to degrade the performance of equipment designed for today's environmental condition. The International Civil Aviation Authority (ICAO) have summarised the impact of climate change on aviation operators[20]. Considering tomorrow's conflicts may be driven by resource competition in areas that will feel the brunt of global temperature rises, the FCAS Enterprise must ensure the products designed today are able to operate across tomorrow's climate - currently estimated between a +2 and +4 global temperate rise - or UK defence will face shortages in equipment availability or be exposed to a reduction in operational performance. Temperate rises are also unlikely to be the same globally, with higher local temperature increases expected depending on the region. This further exacerbates the environmental range equipment will likely have to operate in. Moreover, design and support decisions must also consider the availability and security of sources of critical, exquisite, and rare materials.

- **Infrastructure:** The increasing risk of flooding could pose a threat to existing defence infrastructure. The FCAS programme must ensure that key elements of the FCAS Enterprise, including basing, infrastructure, logistics and supply chain, are resilient to the effects of climate change.

- **Information:** There will likely be a requirement for increased monitoring and forecasting capabilities in the face of climate change. The FCAS programme will need to utilise digital capabilities that will enable the Enterprise to understand the implications of climate change on enterprise configuration, skills development, and technology acquisition.

- **Organisation:** The roles that each of the armed forces have to play is likely to evolve over time to adapt to meet the effects of increased climate change. Multi Domain Integration and coordination across forces and government departments will need to be maintained across a range of emerging climate risk scenarios.

- **Supply Chain:** As temperatures rise, there could be a growing demand for critical supplies and energy requirements to regulate temperatures. Delivery of logistics support could become more difficult due to a climate compromised infrastructure or impeded access through disaster-struck areas.

- **Security:** Extreme weather effects and reducing natural resources will drive mass migration, decrease global stability, and increase the likelihood of conflicts around the world.

Industry must also ensure it identifies and mitigates risks associated with the effects of climate change. It is imperative the FCAS Enterprise acts swiftly to ensure that critical elements - including its supply chain - are reinforced in the face of increasing extreme weather events and that the effects of climate change are included in enterprise risk assessments and actioned accordingly.

[19] https://climateandsecurity.org/a-security-threat-assessment-of-global-climate-change/

[20] https://www.icao.int/environmental-protection/Documents/Factsheet%20Business%20and%20Economics%20Final.pdf

Epoch 1 Ambitions

The FCAS programme should:

- Ensure products and supporting infrastructure are designed for a climate changed world. FCAS will consider and consume the outputs of an ongoing DSTL study that considers the environmental scenarios future defence will likely operate in.

- Ensure products and supporting infrastructure are resilient to extreme weather events, such as powerful storms and higher peak ambient temperatures.

- Perform climate risk assessments across its supporting elements including built environment, support network and supply chain.

- Align with the Sustainable Support Strategy, interoperable with future self-sustaining and sustainable forward/ deployed basing.

- Contribute to SDG's 9 and 13.

Strategic Objective 2

Realise Opportunities for Enterprise Resilience

The Problem

The need for resilience and security in the energy environment today is amplified by the current conflict in Europe where supply of energy - gas and oil - has been weaponised or used as a threat. This action has caused global rise in the cost of energy and contributes significantly to the escalating cost of living currently being experienced in the UK. The current model of fuel procurement exposes the MoD to increasing logistic, operational and financial risk particularly as energy has emerged as a political lever on the geopolitical stage. This is also exacerbated in trends across the wider aviation sector, with civil operators moving towards consuming more Net Zero friendly alternative fuels driven by changing consumer sympathies. As consumers of far more fuel than defence, this will have a profound impact on the increasing price of Jet A-1 fuels as suppliers shift scale production and supply from fossil derived fuels to Sustainable Aviation Fuels (SAFs).

FCAS will also exploit the use of new technologies, materials and digital capabilities not commonly seen in combat aircraft to date, building on a suite of technologies such as batteries and semi-conductors. However, access to rare earth metals and minerals that are vital in these supply chains will become increasingly difficult due to competition with other industries – for example the automotive industry. There is a risk of geopolitical constraints on access to materials too - including "critical minerals" - as China currently mine and process the majority of these resources.[21]

Market/government interventions such as taxes are likely to be introduced to accelerate the transition to a cleaner global energy mix[22]. Other mechanisms, such as voluntary carbon credit offsetting schemes, are mechanisms that are viewed by some as critical for many enterprises in achieving their Net Zero ambitions. Although deemed by some as controversial[23], demand for high quality offset credits is likely to increase dramatically over time, subsequently driving up their costs. Therefore, it is likely that a carbon rich enterprise will be exposed to escalating carbon costs[24] over time, through taxes or the purchase of offsets.

Although initially for defence operators there may be carbon tax exemptions from governments, the future supply chain will not find itself immune to high market carbon costs in the form of carbon credits and taxes.

[21] https://www.theguardian.com/global-development/2021/nov/25/battery-arms-race-how-china-has-monopolised-the-electric-vehicle-industry

[22] https://openknowledge.worldbank.org/handle/10986/35620

[23] https://www.greenpeace.org/international/story/50689/carbon-offsets-net-zero-greenwashing-scam/

[24] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/863717/beis-2019-fossil-fuel-price-assumptions.pdf

The Analysis

Viewing the Enterprise through a lens of sustainable transformation presents a variety of opportunities to improve resilience.

Energy diversification achieved through the use of renewables (wind, tide, solar), hydrogen, nuclear and integrated via solutions such as micro-grids and 'smart-controllers' could act to enhance energy security and resilience. Energy sovereignty can act to remove exposure to geopolitical energy risks such as "energy weaponisation".

Likewise, FCAS should be designed to be able to consume bio SAFs and synthetic fuels defined under ASTM D7566, as part of a wider UK MoD approach to securing fuel sovereignty. Fuel sovereignty has the added benefit of shortening the line of supply, sometimes to zero, particularly where fuels are produced near to or at point of use.

By securing through life access to the materials required for the FCAS systems of systems, utilising the smart application of circular economy principles, the operator will be able to reduce the shocks and stresses that occur in the supply chain that so often drive-up cost and disruption. The ability to reuse, repair, recycle and recover materials and create value in each part of the life-cycle will have a positive effect economically and environmentally as well as contributing to overall supply chain resilience.[25] 'Emerging digital passport legislation, such as the EU's "Digital Product Passport"[26] will build an ecosystem around the sharing of key product related information that will enable a global circular economy; it is imperative that as these emerging policies and technologies are understood, FCAS is positioned to take advantage of them.

The use of "near net" manufacturing techniques such as Additive Layer Manufacturing or 3D printing will reduce the line of supply burden (with associated emissions benefit), whilst also drastically reducing the waste footprint. Parts can be repaired or replaced, with minimal waste and installed onto the FCAS system(s) in a deployed environment.

Ensuring FCAS is Net Zero up front would reduce exposure to financial risks associated with escalating through life carbon costs, for both the programme, and for its supply chain. This will be achieved by adopting a sustainability "business as usual" approach, ensuring sustainability becomes part of the way of working across the programme. The programme will explore choices that can be made to reduce consumption across the programme; examples include utilising the benefits of telepresence communications to reduce travel footprint (also applicable across maintenance); selecting alternative, more recycling friendly materials, insulating buildings and embedding low carbon energy into developing infrastructure; and increasing the use of synthetic simulator training and subsequently reducing the "flown" footprint.

FCAS will align with MoD Climate Change & Sustainability (CC&S) Directorate policy and adopt a no offsets, through purchased carbon credits, approach.

[25] https://www.mckinsey.com/capabilities/sustainability/our-insights/mapping-the-benefits-of-a-circular-economy

[26] https://hadea.ec.europa.eu/calls-proposals/digital-product-passport_en

Epoch 1 Ambitions

The FCAS programme will:

- Embed sustainability into programme governance and engineering processes, ensuring sustainability metrics & KPIs are considered, and evidence provided, at relevant review gates.
- Apply circular economy principles throughout the CADMID life-cycle, including anticipating opportunities for reuse, repurposing (including 2nd life opportunities) and recycling through the life-cycle of the programme. This can be achieved by aligning with the Through Life Services strategy as it is being developed, to ensure cohesion with the obsolescence, termination and disposal plans and future supportability plans.
- Investigate the use of Digital Product Passports throughout the FCAS supply chain.
- Utilise near net manufacturing techniques (e.g. 3D printing) where suitable to reduce waste and reduce line of supply.
- Ensure carbon costs and forecasts are included in cost models, forecasts and business cases and draw upon guidance found in JSP507 part 2.
- Utilise enterprise digital twins, such as Aerogility, to identify opportunities for strategic insertion of diverse, low carbon energy sources across the Enterprise with demonstrable improvements to energy resilience and security.
- Align with the Headmarks from the Strategic Command “Defence Supply Chain Strategy”, and the Strategic Objectives of the “Sustainable Support Strategy”, as well as the “Defence Operational Energy Strategy”.
- Adhere to Support Solutions Envelope 21 Cross Cutting Theme 6, as well as the environmental requirements of GEAR.
- Make contributions to SDG 8 and 12.

Strategic Objective 3

Maximise Contribution to Society

The Problem

Environmental, Social and Governance (ESG) performance is an increasingly important component of modern business practice[28], of which the MoD is no exception. In April 2020, the MoD mandated the use of the "Ministry of Defence's Approach to Investment Decisions" (MAID) process for all business cases, creating an alignment with HM Treasury's Green Book and thus the rest of central government's decision-making process. The adoption of the Green Book principles requires MoD decision-makers to consider the impact on the three pillars of economics, society, and the environment.

Social value is increasingly becoming a metric of emerging importance in government acquisition programmes, through its Social Value in Procurement policy[29] which requires demonstrable evidence against the SVM[30] with social development identified as a thematic priority of the refreshed Integrated Review[31].

However, it is recognised that the defence sector is relatively immature with regards to articulating social value from our programmes; as our collective understanding of addressing social need, risk and opportunity is improved, this strategy will be updated accordingly.

Public and wider stakeholder perception will also play a role in applying ESG pressure on the FCAS Enterprise over time. This will likely influence future programme approval decisions and therefore is something that needs to be understood and planned for today.

The reputation of the UK MoD, FCAS Enterprise and the industry partners, will hang in the balance of whether FCAS can protect our people and can also protect our planet. In order for the programme to demonstrate advantage over the purchase of alternative solutions, it is imperative that the Enterprise is able to demonstrate compliance with UK government policy and regulations and highlight its contributions to improving national value.

[27] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/275550/JSP507_Part_2_U.pdf

[28] https://www.mckinsey.com/~/media/McKinsey/Business%20Functions/Strategy%20and%20Corporate%20Finance/Our%20Insights/Five%20ways%20that%20ESG%20creates%20value/Five-ways-that-ESG-creates-value.ashx

[29] https://www.crowncommercial.gov.uk/news/social-value-procurement-ccs

[30] https://www.gov.uk/government/publications/procurement-policy-note-0620-taking-account-of-social-value-in-the-award-of-central-government-contracts

[31] https://www.gov.uk/government/publications/integrated-review-refresh-2023-responding-to-a-more-contested-and-volatile-world

The Analysis

With a historically tight labour market and workers continuing to rethink their employment prospects, opportunities, and career paths, companies should focus on their ESG performance as a means of effectively retaining and attracting talent.

FCAS has the distinct opportunity to contribute to the mission of the UK government's "Levelling Up" agenda; contributing to focus areas such as developing skills, improving "pride in place", as well as boosting productivity, pay, jobs and - by extension - living standards by growing the private sector.

The majority of the employees that will operate within the FCAS Enterprise through its life are today's school children; they will be increasingly motivated by environmental and social concerns.[32] A recent survey by TalentLMS and BambooHR LLC found that 58% of Gen Z employees want their company to be more environmentally responsible, and 68% find it important to work in a company that is actively committed to social causes.

Demonstrating that defence and the FCAS programme are positively contributing to society will ensure that the industry remains appealing to work in and does not suffer from high staff turnover. Companies with strong ESG and sustainability performance are better able to retain personnel and attract new talent in a competitive labour market for employers.[33] Employees are increasingly looking for meaning in their work and for organisations that reflect their values. A study in 2021 by Edelman found that on average, 79% of employees expect their employer to take action on societal issues and 81% on climate change.

Clean Air Zones (CAZ) and Low Emission Zones (LEZ) are being introduced by the UK government to improve the quality of air around certain hotspots. The FCAS Enterprise has a responsibility to ensure that its manufacturing footprint does not pollute local communities and remains compliant with emerging social/environmental legislation over time.

This strategy lays out ambitions for the FCAS programme to contribute to the UN SDGs, as well as generate evidence against the themes and outcomes of the UK government's SVM (PPN06/20).[34] This will be complimentary to commitments that already have been defined in each of the partner companies' individual Sustainability Strategies.

[32] https://www.nasdaq.com/articles/how-millennials-and-gen-z-are-driving-growth-behind-esg

[33] https://www.aprio.com/how-esg-is-becoming-a-driving-force-in-hiring-and-retention/

[34] https://www.gov.uk/government/publications/procurement-policy-note-0620-taking-account-of-social-value-in-the-award-of-central-government-contracts

FCAS has the following opportunities to contribute to the UN SDGs and these will be refined over time and updated in subsequent issues of this strategy:

UN SDGs	Description	Contribution Opportunities
Quality Education	Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all	Utilise FCAS as a flagship programme for defence sustainability transformation - inspire the next generation through sustainable STEM training
Gender Equality	Achieve gender equality and empower all women and girls	Ensure FCAS aligns with industry and MoD gender equality targets
Affordable and Clean Energy	Ensure access to affordable, reliable, sustainable and modern energy for all	Support industry and RAF's Net Zero transitions to a low carbon, secure and resilient energy enterprise. New technologies developed for FCAS could be rolled out to other industries for clean energy
Decent Work and Economic Growth	Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all	Use FCAS to inspire economic growth across the UK, with a focus on investing in and growing low carbon technologies and developing sustainability skill types.
Industry, Innovation and Infrastructure	Build resilient infrastructure, promote inclusive and sustainable industrialisation, and foster innovation	Use FCAS to promote and encourage climate change awareness across the supply chain and supporting infrastructure. Ensure climate change resilience is built into tomorrow's FCAS Enterprise
Sustainable Cities and Communities	Make cities and human settlements inclusive, safe, resilient, and sustainable	Deliver future air-combat national defence and global influence as a Net Zero capability
Responsible Consumption and Production	Ensure sustainable consumption and production patterns	Actively target waste across the Enterprise - embed circular economy principles across the CADMID life-cycle. Measurably target improved waste reduction and recovery
Life on Land	Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss	Where possible, minimise the negative impact across the UK MoD estate due to future combat system infrastructure and facilities, and exploit opportunities within the estate for offsetting life-cycle emissions.
Partnerships for the Goals	Strengthen the means of implementation and revitalise the global partnership for sustainable development	Utilise FCAS as a flagship programme for defence sustainability transformation for the UK and partner nations

Epoch 1 Ambitions

The FCAS programme will make demonstrable and measurable progress against the themes, KPIs and outcomes of the SVM.

Likewise, FCAS will manage the risk of modern slavery within the supply chain, aligned to PPN 02/23[35] as well as addressing poor labour standards, such as those commonly found in the extraction of raw materials and minerals.

FCAS will make contributions to the UN SDGs 1, 3, 4, 5, 8, 10, 11, as well as ensure parts and materials are sourced responsibly, sustainably, and ethically.

[35] https://www.gov.uk/government/publications/ppn-0223-tackling-modern-slavery-in-government-supply-chains/ppn-0223-tackling-modern-slavery-in-government-supply-chains-guidance-html#:~:text=The%20Modern%20Slavery%20Act%20implemented,Statement%2C%20also%20known%20as%20a%20%3F

Strategic Objective 4

Minimise Negative Contribution to the Environment

The Problem

The RAF is the biggest carbon emitter of the UK Armed Forces, with aircraft a considerable contributor.[36] In recognition of the crucial role the RAF will play in meeting the UK government's Net Zero 2050 ambitions, it has committed to reaching Net Zero emissions by 2040, which would make the RAF the world's first Net Zero air force.

"Climate change is a transnational challenge that threatens global resilience and our shared security and prosperity. I am determined to tackle this head on and have set the Royal Air Force the ambitious goal to be Net Zero by 2040."

Chief of the Air Staff, Royal Air Force

The ambition is laid out in the RAF's Net Zero 2040 Strategy.[37] It has three end goals:

1. Net negative estate: Through careful land management, and use of renewable energy and electric vehicles, RAF bases will contribute to carbon sequestration.

2. Net Zero aviation: RAF air and spacecraft to minimise emissions through novel technologies.

3. Net Zero business as usual: RAF is Net Zero across the whole force, with an ethos and culture that supports sustainability through innovative and data-driven decisions.

The "Net Zero aviation" goal is further developed by the recently published Defence Aviation Net Zero Strategy, covering five main themes:

- ***Rethinking Capability Provision***
- ***Efficiency Improvements***
- ***Sustainable Aviation Fuel***
- ***Zero Emissions Propulsion***
- ***Carbon Removals***

[36] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1090612/20220714_MOD-ARA_2021-22.pdf

[37] https://www.gov.uk/government/speeches/cas-raf-netzero-ambition

Given that FCAS is intended to be the RAF's principal combat air system for decades to come, these larger goals **cannot** be achieved if FCAS is not a sustainable enterprise. The demand on FCAS is even more challenging because, to ensure alignment with this wider ambition, it effectively must be sustainable by 2035 when the platforms are due to come into service.

The primary FCAS partners - BAE Systems, Rolls-Royce, Leonardo UK and MBDA UK - made up four of the top six GHG-emitting arms corporations in the UK between 2017-2018, 39% of the total of UK Defence industry as a whole[38].

FCAS is also likely to operate in an environment of continuous change, necessitating the need to upgrade and modify at an increased cadence. This generates regular opportunities to generate significant waste and carbon throughout the design organisation and supply chain. Whilst carbon and the Net Zero challenge is often given the most attention and energy, the programme must also consider the non carbon/GHG aspects of sustainability; such as Nitrous Oxides (NOx), solid and liquid waste, water conservation, hazardous materials and substances (e.g. F-gases) and biodiversity.

At this stage of the programme, the FCAS Enterprise is in a unique position to reduce the potential environmental footprint and have a significant impact on overall GHG emissions from the military-industrial sector, leading to a more positive perception of the FCAS Enterprise. To do this, the programme must act as leaders in innovation and sustainability.

The Analysis

In order to meet the challenge set by the RAF's Net Zero 2040 strategy, the programme needs to develop an understanding of the sources of emissions attributable to the FCAS Enterprise and ensure it can influence and mitigate them accordingly. Decarbonisation commitments within the FCAS programme should be created and must be viewed as an accelerated subset of existing industry and MoD Net Zero commitments.

Due to their potential to remove up to 80% of through life emissions[39] compared to traditional aviation fossil fuels through life, it is imperative the programme ensures fuel consuming elements of the FCAS Enterprise are compatible with SAFs, including synthetic fuels.

Recent changes in aviation fuel standards mean in-service aircraft may use blends of up to 50% sustainable aviation fuel (SAF). These standards are used by the UK's commercial and civil aviation sectors and have also been adopted by many other countries. The RAF has embraced emerging fuel technologies as a potential means to reach their Net Zero ambitions, achieving a world first flight with 100% synthetic fuel in 2021[40], and flying a Multi Role Tanker Aircraft with 100% SAF in 2022.[41]

The built environment and supporting infrastructure of FCAS will also play a significant role with regards to the sustainability targets. The use of renewable and low/zero carbon energy across sites will be a critical tool in reducing emissions. Requirements for new and retrofitted infrastructure requires sustainability consideration and provides an opportunity to make choices to build sustainably, saving energy, and improving resilience.

A fresh approach to licencing across the international partnership could also introduce environmental benefit; for example, allowing partners to build/repair under licence, as opposed to importing product, could reduce the overall logistical emissions footprint in the operational phase of the product life-cycle.

FCAS should also act to reduce the impact of "non carbon" environmental impacts such as reducing waste, water toxicity, and use of hazardous materials, whilst promoting biodiversity across the estate.

The Jet Zero Council are also promoting work that further develops an understanding around the non-CO2 emissions associated with operations, such as nitric oxides. It is important that FCAS remains compliant with developing emissions reporting requirements as they possibly change over time.

This must all be considered in the early planning and concept phases to ensure the strategic ambitions are met.

[39] https://www.bp.com/en/global/air-bp/news-and-views/views/what-is-sustainable-aviation-fuel-saf-and-why-is-it-important.html

[40] https://www.gov.uk/government/news/world-record-raf-flight-powered-by-synthetic-fuel

[41] https://www.airbus.com/en/newsroom/press-releases/2022-11-airbus-a330mrtt-completes-first-100-saf-test-flight-on-both-engines

Epoch 1 Ambitions

The FCAS programme will:

Underpin sustainability as part of everything the Enterprise does as a programme. At every trade off and decision point, the implications of the environmental impact should be considered.

- Consider the use of Life-Cycle Assessments (LCA) to understand the environmental impact of components, across emissions, solid and liquid wastes, water toxicity etc.

- Use circular economy principles to promote a low waste culture

Ensure the Power & Propulsion System system and interfacing systems are SAF and synthetic fuel compatible.

Reduce the loss of water, oils and lubes across manufacturing.

Identify, agree and commit to carbon management and reduction standards, develop an emissions baseline for the programme, and develop and agree a scope 1, 2 and 3 emissions reduction roadmap attributable to the FCAS Enterprise.

- Measure current carbon footprint across the programme, and use digital tools to forecast Scope 1, 2 and 3 emissions through life, across a variety of operational, environmental and product scenarios.

- Develop environmental KPIs & targets, and measure progress towards targets each year.

FCAS must contribute to the Ends defined in the RAF's Net Zero 2040 Strategy, by delivering a Net Zero programme:

- Net Zero estate: Identify and understand Epoch 2 requirements reducing estate emissions across FCAS footprint. Supporting estate, equipment, and infrastructure for FCAS platforms, personnel and logistics must use renewable energy sources to actively reduce their total carbon equivalent emissions to zero. Promotion of biodiversity and usage of both natural and man-made (e.g. Direct Air Capture) carbon removal.

- Net Zero Aviation: Ensure fuel consuming products are designed to use alternative fuels (synthetic, SAF, hydrogen). Life-cycle assessments could be conducted to ensure FCAS platforms are Net Zero throughout the whole CADMID/T cycle, and circular economy principles must become a part of the design toolkit. FCAS must influence suppliers and manufacturers to commit to decarbonisation targets and ensure transparent emissions reporting.

- Net Zero business as usual: FCAS must see a step-change in ethos and culture across all partners, using technology and data to make sustainability-informed decisions. This must cover all areas of business – from the day to day e.g. travel reduction using virtual conferencing and remote working, to major projects such as the maintenance of FCAS platforms.

Make contributions to SDG's 6, 7, 12, 13, 14, 15.

Strategic Objective 5

Maximise Contribution to the National Value Framework

The Problem

The FCAS programme links directly to the NVF and, by extension, the framework for National Value in Combat Air.

The FCAS programme already has over 3,000 people working across MoD and our industry partners, which continues to grow across the breath of the UK. The programme is committed to the development of advanced skills and industrial technologies, with MoD already investing £1.1Bn in the FCAS Technology Initiative for research and development, while industry has spent over £600m.

To align with the Combat Air Strategy, it must demonstrate value across the following dimensions:

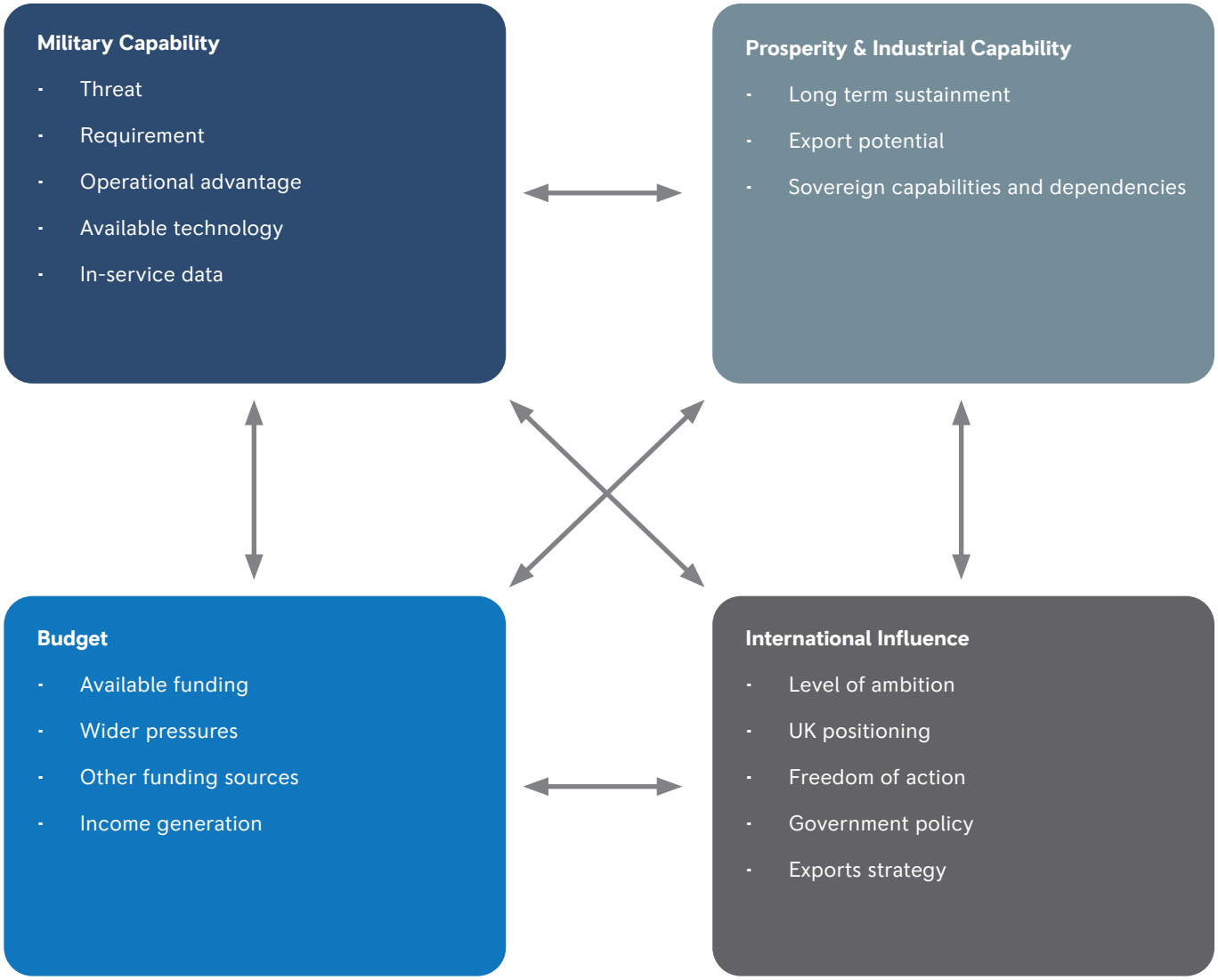


Figure 2 - National Value Framework

Sustainability within the programme must be able to demonstrate its contribution to the NVF.

The Analysis

A sustainable FCAS Enterprise will contribute to the NVF in a variety of ways. Through the investment in innovative, emerging sustainable technologies, such as SAF, the UK will develop sovereign capabilities that act to ease global supply pressures and improve export potential as other countries look for more sustainable options. A sustainable FCAS programme will align with the UK's ambition to stimulate UK growth, and also to reinforce the UK's position as a global sustainability leader post COP26.

The military capability section of the framework encompasses the core purpose of FCAS, developing a future capability to ensure operational advantage and maintain a military edge over adversaries. As is addressed in this strategy document, creating a more sustainable FCAS will mean improved operational support and supply resilience, and therefore has a direct influence on our future military capability.

The development of sustainable technologies and the transformation of "the way we work" links to the long term sustainment and sovereign capabilities covered in the prosperity and industrial capability section. FCAS programmes across industry are contributing to the UK's STEM skills base, and a solid sustainability focus will ensure the brightest future minds are recruited and retained in this critical national industry. A sustainable FCAS Enterprise should boost high skilled jobs in an emerging technology sector, increasing the number of apprenticeships and jobs in regional areas – for example the Northeast is an emerging hydrogen hub.[43] Investments in developing a synthetic fuel manufacturing capability could create opportunities to sell fuels to secondary markets, leading to emerging developing markets and new revenue streams across the UK supply chain.

The focus on international influence has meant, through GCAP, the UK has secured effective and efficient partnerships with Japan and Italy. With ambitions to be aspirational thought leaders in sustainability, the GCAP partners have the opportunity to directly influence sustainability choices internationally.

FCAS doesn't yet consider sustainability as a "measure of goodness" within the Work Package 1 concept assessment approach. In order for sustainability to success on this programme, and to support the sustainability Key User Requirement (KUR), the Enterprise needs to ensure that sustainability becomes one of the primary measures for concept development and selection.

[43] https://www.business-live.co.uk/enterprise/north-easts-position-uk-hydrogen-24885251

Epoch 1 Ambitions

The FCAS programme will:

- Embed sustainability at the heart of the international programme.
- Influence international partner commitments and policy around sustainability.
- Explore non-traditional, sustainability focused funding sources.
- Commit a demand signal into the SAF fuels industry, boosting their prosperity.
- Invest in and develop UK “green” industry and academia, collaborating with SMEs and universities.
- Articulate its contribution to the UK economy including, but not limited to, the following indicators:
    - Full Time Equivalent (FTE) jobs created/ supported including in areas of relative economic disadvantage
    - Gross Value Added (GVA) contribution to UK GDP
    - Investments made with SMEs, UK suppliers and suppliers in areas of relative economic disadvantage
    - Invested spend on R&D
    - FCAS contribution to government tax revenues.
- Make contributions to SDG’s 8, 9, 11, 16 and 17.

Climate Change and Sustainability Enablers

This strategy will be developed completely in alignment with the ambitions and direction of the work of the MoD's Climate Change and Sustainability Directorate. The programme will use common templates, baselines, and approaches to ensure commonality across the rest of defence.

FCAS will need a robust and detailed baseline that attributes emissions to specific activities, goods and services. It will need decarbonisation pathways and roadmaps for enabling technologies. FCAS will support the MoD Climate Change and Sustainability Directorate and sector leads to deliver, and will use it to inform any trade-offs and investment decisions.

FCAS can act as a vessel to develop defence climate literacy, behaviours and skills: defence would benefit from a shared understanding of sustainability, a common lexicon and behaviour change. This could be delivered by the FCAS programme to upskill defence leaders across MoD and industry on this topic and sharing best practices.

FCAS Programme – Success for Epoch 1 (2025)

This phase is defined by formally defining sustainability requirements across the organisation. It is recognised that frameworks, policies and approaches may change and develop over the coming years as the sustainability topic matures across industry. Therefore, the ambitions of this document are likely to evolve over time and the strategy subsequently reissued.

This phase will pilot various sustainability projects across FCAS to fully understand the route to achieve the ambitions of this strategy document.

This means developing new skills, capabilities and mindsets; personnel through the Enterprise will need to investigate, innovate and initiate sustainability activities; circular economy principles will become a key part of the design and operating toolkit.

This means developing the means, methods and standards that will allow the programme to baseline and forecast the environmental impact of the FCAS system(s) and its supporting enterprise.

This means collaboratively developing and committing to carbon reduction and mitigation roadmaps, informed by science based targets, and driving these through the value chain.

A comprehensive baseline and database will be built to allow decisions on a detailed plan for all themes in Epochs 2 and 3.

REF: VCOMB 4163